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10/777,026	02/11/2004	Mark N. Kawaguchi	8033/ETCH	2197

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EXAMINER

TRAN, BINH X

ART UNIT PAPER NUMBER

1765

DATE MAILED: 05/11/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/777,026

Applicant(s)

KAWAGUCHI ET AL.

Examiner

Binh X. Tran

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 April 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-32 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 8-30-04.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Group I (claims 1-32) in the reply filed on 4-11-2006 is acknowledged.

Claim Objections

2. Claim 28 is objected to because of the following informalities: In line 4 of claim 28, the examiner suggests applicants insert a comma (i.e. ",") after the term "nitrogen". Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 9, 13-16, 19-20, 22, 24 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 9, the applicants write, "wherein in the hydrogen-containing gas comprises at least one of hydrogen, water vapor, oxygen and nitrogen" (emphasis added). Where applicant acts as his or her own lexicographer to specifically define a term of a claim contrary to its ordinary meaning, the written description must clearly redefine the claim term and set forth the uncommon definition so as to put one reasonably skilled in the art on notice that the applicant intended to so redefine that claim term. *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350, 1357, 52

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USPQ2d 1029, 1033 (Fed. Cir. 1999). The term "hydrogen-containing gas" in claim 9 is used by the claim to mean "at least one of hydrogen, water vapor, oxygen and nitrogen". It is well known in the art that hydrogen and water vapor (i.e. H₂O vapor) is a hydrogen-containing gas. However, oxygen and nitrogen are not hydrogen containing gas. The term is indefinite because the specification does not clearly redefine the term.

Claims 13-16, 19-20 are indefinite because they directly depends on indefinite claim 9.

Claim 22 depends on independent claim 21. In the independent claim 21, applicants recite the step of "heating the substrate to a temperature of at least 150 °C". However, in claim 22 applicants provide a new contradicted limitation "the temperature of the substrate between 50 °C and 400 °C". Once applicants define the temperature of at least 150 °C in the independent claim, applicants cannot provide a new contradicted limitation in the dependent claims (i.e. temperature at 50 °C).

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

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6. Claims 1-3, 7-9, 10-12, 14-16, 19-23, 29-30 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen et al. (US 5,545,289).

Respect to claims 1-2, Chen discloses a method for removing halogen-containing residue from a substrate, the residue formed during the etching of the substrate (col. 5 lines 1-6), the method comprising the steps of:

heating the etched substrate to the temperature about 150°C to 400 °C (read on applicant's range of "at least 50 °C" and/or "50 °C to about 450 °C [claim 2]; See col. 8 lines 50-60);

exposing the heated substrate to a plasma that removes the halogen-containing residues, col. 8 lines 60-67, col. 13-14, Table I).

Respect to claim 3, Chen discloses forming the plasma by energizing a gas mixture in a remote plasma reactor (54) (See Fig 2). Respect to claim 7, Chen discloses the halogen-containing residue comprises chlorine (col. 5 lines 1-5). Respect to claims 8-9, Chen discloses the plasma comprises water vapor (i.e. hydrogen-containing gas), oxygen and nitrogen (See Table I in col. 13 and 14). Respect to claim 10, Chen discloses the heating step comprises heating the substrate in a gas mixture of oxygen and nitrogen (Table I). Respect to claim 11, Chen discloses the temperature of about 250 °C (Table I, example 2-6). Respect to claim 12, Chen teaches to use 3000 sccm of oxygen and 300 sccm of nitrogen (col. 13 lines 38-42). The flow ratio of oxygen to nitrogen equals to $3000:300 = 10:1$.

Respect to claim 14, Chen discloses the passivating gas comprises 3000 sccm O₂ and 300 sccm NH₃ (read on applicant's forming gas). Respect to claims 15-16, Chen

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discloses the flow rate of water vapor is about 300 sccm (Table I, read on applicant's range of 100-3000 sccm) and the flow rate of oxygen is about 3000 sccm. The flow ratio of oxygen to water vapor equals to $3000 \text{ sccm} / 300 \text{ sccm} = 10:1$. Respect to claims 19-20, Chen discloses the pressure of about 1-10 torr, preferably about 2 Torr (col. 6 lines 52-63) and the duration for the exposing step is about 40-60 seconds (table I, example 1-2, 8).

Respect to claim 21, Chen further discloses the steps of: providing a substrate (20) having a film stack on the substrate with a patterned mask (resist mask 26) on the film stack (See Fig 1a); etching the film stack on the substrate. The limitation of claims 22-23, 29-30 has been discussed above.

7. Claims 1-2, 4, 7 are rejected under 35 U.S.C. 102(b) as being anticipated by Ogawa et al. (US 5,306,671).

Respect to claims 1-2, Ogawa discloses a method for removing halogen-containing residue from a substrate, the residue formed during the etching of the substrate (col. 4 lines 30-41), the method comprising the steps of:

heating the etched substrate to the temperature about 250 °C (read on applicant's range; See col. 4 lines 50-55);

exposing the heated substrate to a plasma that removes the halogen-containing residues, col. 4 lines 45-67, col. 6 lines 14-20, col. 7 lines 50-55).

Respect to claims 4 and 7, Ogawa discloses the halogen-containing residues comprises bromine and/or chlorine (col. 7 lines 1-11). Respect to claims 8-9, Ogawa discloses the plasma comprises hydrogen gas (col. 4 lines 54-67, col. 8 lines 1-4).

8. Claims 1-2, 7 are rejected under 35 U.S.C. 102(e) as being anticipated by Nallan et al. (US 2004/0007561)

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Respect to claims 1-2, Nallan discloses a method for removing halogen-containing residue from a substrate, the residue formed during the etching of the substrate (paragraph 0019), the method comprising the steps of:

heating the etched substrate to the temperature about between 100-500 ° C (read on applicant's range; See paragraph 0023);

exposing the heated substrate to a plasma that removes the halogen-containing residues, paragraph 0026-28).

Respect to claim 7, Nallan discloses the etching gas is chlorine and the cleaning gas is used for remove post etch residues from the wafer surface. Since the etching gas is the chlorine gas, it is inherently that the residues must comprise chlorine.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 5-6, 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ogawa in view of Chen.

Respect to claims 5-6, Ogawa fails to disclose the plasma comprises oxygen-containing gas and an additive selected from the group consisting of nitrogen, argon and helium. In a method for removal halogen residues, Chen teaches to use oxygen plasma and an additive comprises N₂ (Table I). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Ogawa by using the above gas because they will remove residues from the wafer and enhance corrosion resistance.

Respect to claims 17-18, Chen discloses the pressure of about 1-10 torr, preferably about 2 Torr (col. 6 lines 52-63) and the duration for the exposing step is about 40-60 seconds (table 1, example 1-2, 8).

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12. Claims 13, 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Ogawa.

Respect to claims 13 and 31, Chen fails to disclose the use of hydrogen gas in combination with oxygen and water vapor. However, Chen clearly teaches to use water vapor and oxygen gas. Chen further discloses to use hydrogen-containing gas in order to activate hydrogen radicals (col. 6 lines 45-50). Ogawa teaches to use hydrogen reducing gas in order to enhance halogen-containing residues via radical reaction (col. 4 lines 45-67, col. 7 lines 50-55). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Chen in view of Ogawa by using hydrogen gas because it dissociates and remove halogen residues absorbed on the surface of the semiconductor.

Claim 13 further differ from Chen by the specific flow ratio of oxygen to hydrogen and hydrogen to water vapor. However, Chen clearly teaches to change the flow rate of individual gas and flow rate ratio are result effective variables (col. 7 lines 25-31, col. 8 lines 25-35, Table I, col. 13 lines 40-42, Table IV). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment in order to obtain optimal flow rate ratio as an expected result.

Respect to claim 32, Chen discloses heating the substrate in the gas mixture of oxygen and nitrogen (Table I)

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13. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Powell (US 6,265,297).

Respect to claim 24, Chen fails to disclose the etching the film stack comprises etching the polysilicon layer. However, Chen clearly teaches to etch the film stack comprises metal layer and silicon layer (col. 4 lines 61-62). In a semiconductor process, Powell discloses a film stack comprises metal/polysilicon layer (56) (col. 3 lines 56-65). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Chen in view of Powell by having polysilicon layer because metal/polysilicon gate stack is a well-known structure in semiconductor process. Further, a metal/polysilicon gate stack is result in multi-layer structures.

14. Claims 25-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Ye et al. (US 6,331,380).

Respect to claim 25, Chen fails to disclose the etching the substrate having a film stack with a gas mixture comprising a halogen gas and a reducing gas. However, Chen clearly teaches to etch a film stack having metal layer by using halogen gas (BCl_3 and Cl_2). Ye teaches to etch metal stack layer by using halogen-containing gas in addition with hydrogen gas (read on reducing gas, col. 17 lines 54-67). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Chen in view of Ye by adding reducing gas hydrogen gas would provide protection of etched surface, thereby preventing penetration by reactive species adjacent to the etch surface (col. 17 lines 60-67).

Respect to claim 26, Ye teaches to use HBr gas for etching the surface (col. 17 lines 35-67). Since HBr is use as an etching gas, the residues from the etching step must comprise bromine. Respect to claim 27-28, Chen teaches to use oxygen plasma, water vapor and an additive comprises N₂ (Table I).

Conclusion

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X. Tran whose telephone number is (571) 272-1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Binh Tran

Binh X. Tran